Growth to survive: potential hydraulic implications of low growth in oaks.

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Forest management faces a challenge in implementing silvicultural treatments to improve the trees' adaptation to the water deficit. The limited radial growth is associated with a higher risk of cavitation, caused by limited hydraulic conductivity per leaf area or by anatomical features of the xylem. To avoid runaway embolism, the existence of "hydraulic bridges" between main vessels has been proposed as a safety mechanism. This study aims to reveal the main causes that contribute to the increased vulnerability associated with reduced growth in *Quercus pyrenaica* trees in an abandoned coppice area located in Cubel, Zaragoza, on an anatomical and micromorphological level. In particular, we measured the distance between spring vessels of same year (D), the distance between the vessels of one year and the spring vessels of the previous year (D_{-1}), vessel area (VA), hydraulic bridges within the same year (Hb) and hydraulic bridges with the previous year (Hb_{-1}). For each parameter, we obtained 6 measurements per sample, resulting in a total of 30 measurements (5 samples x 6 measurements). Our findings show that there have been changes in the growth rate dynamics of these trees over the last five years (2017-2021), evidenced by changes in anatomy. We found a significant reduction in growth was observed with a decrease in the width of the rings, particularly in the last two years analyzed (2020 and 2021). This caused a significant decrease both in the distance and number of the hydraulic bridges between the vessels of consecutive years (D_{-1} and Hb_{-1}). In contrast we did not find differences in the VA, D and Hb. In the last two years, we detected the formation of discontinuous rings (without the formation of spring vessels in some radii) and the presence of tyloses, even in the newly formed vessels (2021), indicating a high level of cavitation. Using Scanning Electron Microscopy (SEM), we observed the connection between the vessels through pit torus, which is a crucial element for maintaining conductivity and resistance to water flow between the vessels. We concluded that reduced growth could increase the risk of vulnerability due to cavitation by decreasing the distance and number of hydraulic bridges between the previous and current year's vessels. Therefore, it is necessary to adopt a maintenance system that can reactivate the growth of these trees and maintain the future status of the forest.